Operating Instructions

Capacitive cable electrode for continuous level measurement

VEGACAL 66

Foundation Fieldbus

Document ID: 30038

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Supplementary documentation

Information:
Supplementary documents appropriate to the ordered version come with the delivery. You can find them listed in chapter "*Product description*".

Instructions manuals for accessories and replacement parts

Tip:
To ensure reliable setup and operation of your VEGACAL 66, we offer accessories and replacement parts. The corresponding documentations are:

- 27720 - VEGADIS 61
- 30531 - Electronics module VEGACAL series 60
- 34296 - Protective cover
- 31088 - Flanges according to DIN-EN-ASME-JIS

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1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained specialist personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

Battery disposal
This symbol indicates special information about the disposal of batteries and accumulators.

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2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

VEGACAL 66 is a sensor for continuous level measurement.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

2.5 Safety label on the instrument

The safety approval markings and safety tips on the device must be observed.

2.6 CE conformity

This device fulfills the legal requirements of the applicable EC guidelines. By attaching the CE mark, VEGA provides a confirmation of successful testing. You can find the CE conformity declaration in the download area of "www.vega.com".

2.7 Fulfillment of NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and display/adjustment components

For further information see www.namur.de.

2.8 Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

2.9 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfill this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

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3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- Level sensor VEGACAL 66
- Documentation
  - this operating instructions manual
  - Operating instructions manual 27835 "*Display and adjustment module PLICSCOM*" (optional)
  - Supplementary instructions manual 31708 "*Heating for display and adjustment module*" (optional)
  - Supplementary instructions manual "*Plug connector for continuously measuring sensors*" (optional)
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - if necessary, further certificates

Constituent parts

The VEGACAL 66 consists of the components:

- Process fitting with probe
- Housing with electronics
- Housing cover, optionally available with display and adjustment module

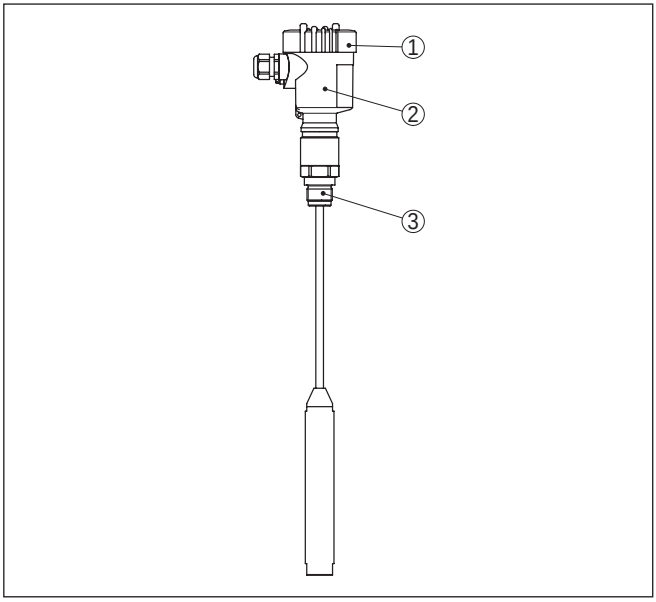

Fig. 1: VEGACAL 66 - cable version with plastic housing

1 Housing cover with integrated display and adjustment module (optional)
2 Housing with electronics
3 Process fitting

Type plate

The nameplate contains the most important data for identification and use of the instrument:

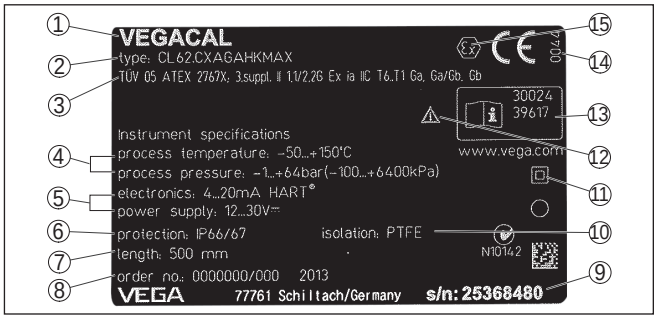

Fig. 2: Layout of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Approvals*
4 *Process and ambient temperature, process pressure*
5 *Power supply and signal output, electronics*
6 *Protection rating*
7 *Probe length*
8 *Order number*
9 *Serial number of the instrument*
10 *Material, wetted parts*
11 *Symbol of the device protection class*
12 *Reminder to observe the instrument documentation*
13 *ID numbers, instrument documentation*
14 *Notified authority for CE marking*
15 *Approval directives*

With the serial number, you can access the delivery data of the instrument via www.vega.com, "*VEGA Tools*" and "*serial number search*". In addition to the type label outside, you can also find the serial number on the inside of the instrument.

3.2 Principle of operation

Area of application

VEGACAL 66 is a level sensor with fully insulated probe for continuous level measurement.

The electronics functions according to the admittance principle (phase-selective admittance processing).

It is designed for industrial use in all areas of process technology and can be applied in all areas of industrial process measurement.

Fully insulated probes such as VEGACAL 66 are used in liquids and solids; preferably in conductive products.

Functional principle

Probe, measured product and vessel wall form an electrical capacitor. The capacitance is influenced by three main factors.

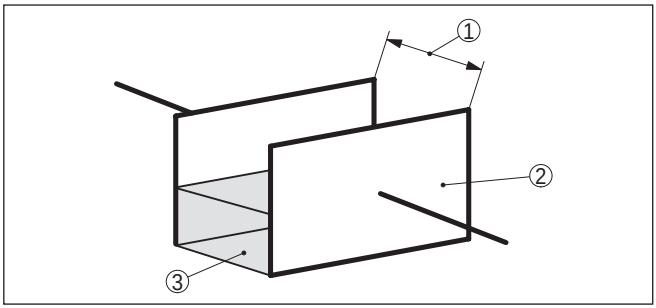

Fig. 3: Functional principle - Plate capacitor

1 Distance between the electrode surfaces
2 Size of the electrode surfaces
3 Type of dielectric between the electrodes

The probe and the vessel wall are the capacitor plates. The measured product and the insulation are the dielectric. Due to the higher dielectric constant of the insulation and the conductive product compared to air, the capacitance increases as the probe is gradually covered.

The capacitance as well as the resistance change are converted by the electronics module into a level-proportional signal.

Power supply and bus communication

Power is supplied via the H1 Fieldbus. A two-wire cable according to Fieldbus specification serves as carrier of both power and digital data for multiple sensors. This cable can be operated in two versions:

- via an H1 interface card in the control system and additional power supply
- via a Linking device with HSE (High speed Ethernet) and additional power supply according to IEC 61158-2

DD/CFF

The DD (Device Descriptions) and CFF (capability files) necessary for planning and configuration of your FF (Foundation Fieldbus) communication network are available in the download area of the VEGA homepage www.vega.com under "*Services - Downloads - Software - Foundation Fieldbus*". The appropriate certificates are also available there. A CD with the appropriate files and certificates can be ordered via e-mail under info@de.vega.com or by phone from one of the VEGA agencies under the order number "DRIVER.S".

The backlight of the display and adjustment module is powered by the sensor. Prerequisite is a certain level of operating voltage.

The data for power supply are specified in chapter "*Technical data*".

The optional heating requires its own operating voltage. You can find details in the supplementary instructions manual "*Heating for display and adjustment module*".

This function is generally not available for approved instruments.

3.3 Operation

The instrument can be adjusted with the following adjustment media:

- With the display and adjustment module
- with the suitable VEGA DTM in conjunction with an adjustment software according to the FDT/DTM standard, e.g. PACTware and PC
- a configuration tool

3.4 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

3.5 Accessories and replacement parts

PLICSCOM

The display and adjustment module PLICSCOM is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor or the external display and adjustment unit and removed at any time.

You can find further information in the operating instructions "*Display and adjustment module PLICSCOM*" (Document-ID 27835).

VEGACONNECT

The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, the adjustment software PACTware with VEGA-DTM is required.

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You can find further information in the operating instructions "*Interface adapter VEGACONNECT*" (Document-ID 32628).

VEGADIS 62

VEGADIS 62 is suitable for measured value indication and adjustment of sensors with HART protocol. It is looped into the 4 … 20 mA/HART signal cable.

You can find further information in the operating instructions "*VEGADIS 62*" (Document-ID 36469).

Protective cap

The protective cover protects the sensor housing against soiling and intense heat from solar radiation.

You will find additional information in the supplementary instructions manual "*Protective cover*" (Document-ID 34296).

Flanges

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, BS 10, ANSI B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*" (Document-ID 31088).

4 Mounting

4.1 General instructions

Suitability for the process conditions

Make sure that all parts of the instrument coming in direct contact with the process, especially the sensor element, process seal and process fitting, are suitable for the existing process conditions, such as process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" and on the nameplate.

Installation position

Select an installation position you can easily reach for mounting and connecting as well as later retrofitting of a display and adjustment module. The housing can be rotated by 330° without the use of any tools. You can also install the display and adjustment module in four different positions (each displaced by 90°).

Welding work

Before beginning the welding work, remove the electronics module from the sensor. By doing this, you avoid damage to the electronics through inductive coupling.

Handling

With threaded versions, the housing must not be used to screw in the instrument. Applying tightening forces on the housing can damage its internal parts.

Use the hexagon for screwing in.

Moisture

Use the recommended cables (see chapter "*Connecting to power supply*") and tighten the cable gland.

You can give your instrument additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

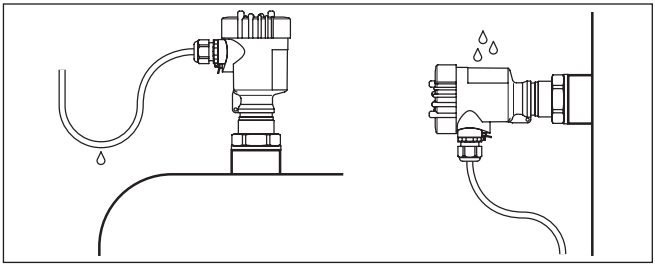

Fig. 4: Measures against moisture penetration

Pressure/Vacuum

The process fitting must be sealed if there is gauge or low pressure in the vessel. Before use, check if the seal material is resistant against the measured product and the process temperature.

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The max. permissible pressure is specified in chapter "*Technical data*" or on the type label of the sensor.

Insulating measures, such as e.g. covering the thread with teflon tape, can interrupt the necessary electrical connection with metal vessels. For this reason, ground the probe on the vessel or use a conductive seal material.

Vessel material

Metal vessel

Make sure that the mechanical connection of the probe to the vessel is electrically conductive to ensure sufficient grounding.

Use conductive seals, such as those made of copper or lead, etc. Insulating measures, such as covering the thread with Teflon tape, can interrupt the necessary electrical connection with metal vessels. For this reason, ground the probe on the vessel or use a conductive seal material.

Non-conductive vessels

In non-conductive vessels, e.g. plastic tanks, the second pole of the capacitor must be provided separately.

Vessel forms

If possible, the capacitive probe should be mounted vertically or parallel to the counter electrode. This applies particularly to applications in non-conductive products.

In cylindrical tanks, spherical tanks or other asymmetrical tank forms, nonlinear level values are generated due to the varying distance to the vessel wall.

Use a concentric tube in non-conductive products or linearize the meas. signal.

4.2 Mounting instructions

Installation position

During operation, the probe must not touch any installations or the vessel wall. The measured value can also change if the distance to the vessel wall changes considerably. If necessary, secure the end of the probe (insulated).

In the gravity weight there is a thread (M12), e.g. for a ring bolt (optional) - (article no. 2.27424). The gravity weight is isolated from the measuring cable.

Make sure that the probe cable is not completely taut. Avoid tensile loads on the cable.

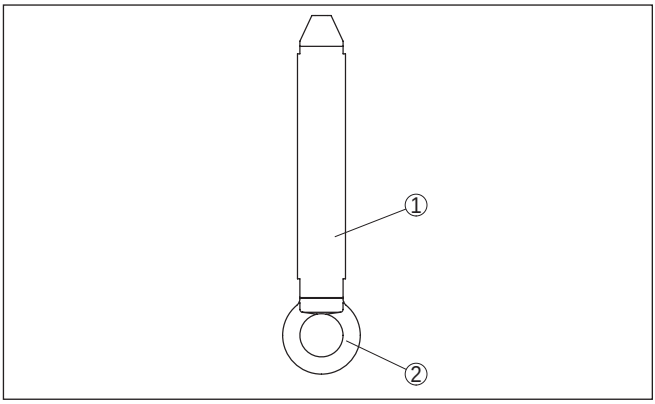


Fig. 5: Fasten the probe

1 Gravity weight
2 Lug M12 (article no. 2.27423)

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then possible down to the lowest point of the vessel bottom.

Caution:
It is not possible to measure on the gravity weight. The measuring range of the probe ends at the upper edge of the gravity weight.

Inflowing medium

If the instrument is mounted in the filling stream, unwanted false measurement signals can be generated. For this reason, mount the instrument at a position in the vessel where no disturbances, e.g. from filling openings, agitators, etc., can occur.

This applies particularly to instrument versions with a longer probe.

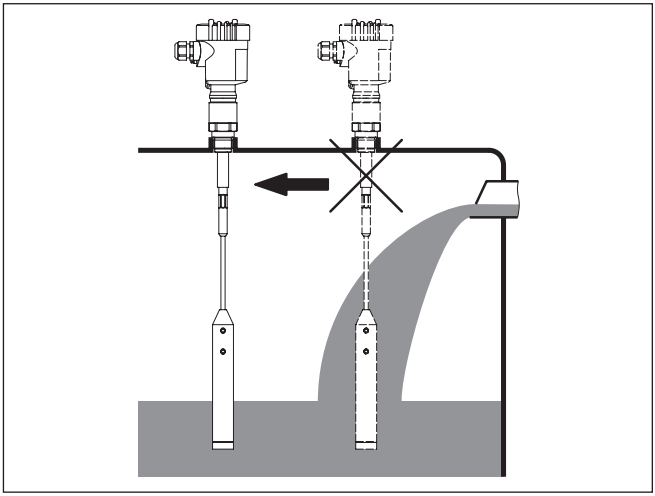


Fig. 6: Inflowing medium

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed according to Foundation Fieldbus specification

Tip:
We recommend VEGA overvoltage arrester B63-32.

In hazardous areas you must take note of the respective regulations, conformity and type approval certificates of the sensors and power supply units.

Voltage supply

The instrument requires a operating voltage of 9 … 32 V DC. Operating voltage and the digital bus signal are carried on the same two-wire connection cable. Power is supplied via the H1 power supply.

Connection cable

Connection is carried out with screened cable according to Fieldbus specification.

Use cable with round cross-section. A cable outer diameter of 5 … 9 mm (0.2 … 0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.

Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

Cable gland ½ NPT

On the instrument with cable entry ½ NPT and plastic housing there is a metallic ½" threaded insert moulded into the plastic housing.

Caution:
No grease should be used when screwing the NPT cable gland or steel tube into the threaded insert. Standard grease can contain additives that corrode the connection between threaded insert and housing. This would influence the stability of the connection and the tightness of the housing.

Cable screening and grounding

With systems with potential equalisation, connect the cable screen directly to ground potential at the power supply unit, in the connection box and at the sensor. The screen in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).

In systems without potential equalisation, connect the cable screen directly to ground potential at the power supply unit and at the sensor. In the connection box or T-distributor, the screen of the short stub to the sensor must not be connected to ground potential or to another cable screen. The cable screens to the power supply unit and to the next distributor must be connected to each other and also connected to ground potential via a ceramic capacitor (e.g. 1 nF, 1500 V). The

low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

The total capacitance of the cable and of all capacitors must not exceed 10 nF in Ex applications.

Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

5.2 Connection procedure

Proceed as follows:

1. Unscrew the housing cover
2. If a display and adjustment module is installed, remove it by turning it to the left.
3. Loosen compression nut of the cable entry
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry
6. Lift the opening levers of the terminals with a screwdriver (see following illustration)
7. Insert the wire ends into the open terminals according to the wiring plan

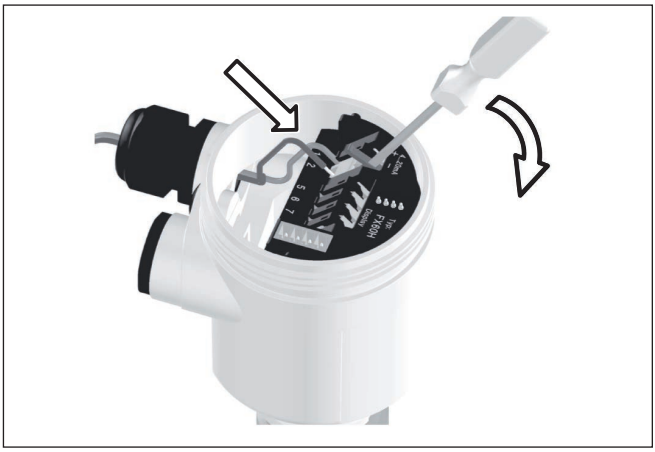


Fig. 7: Connection steps 6 and 7

8. Press down the opening levers of the terminals, you will hear the terminal spring closing
9. Check the hold of the wires in the terminals by lightly pulling on them

10. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation
11. Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable
12. Screw the housing cover back on

The electrical connection is hence finished.

5.3 Wiring plan, single chamber housing

The following illustrations apply to the non-Ex as well as to the Ex-ia version.

Housing overview

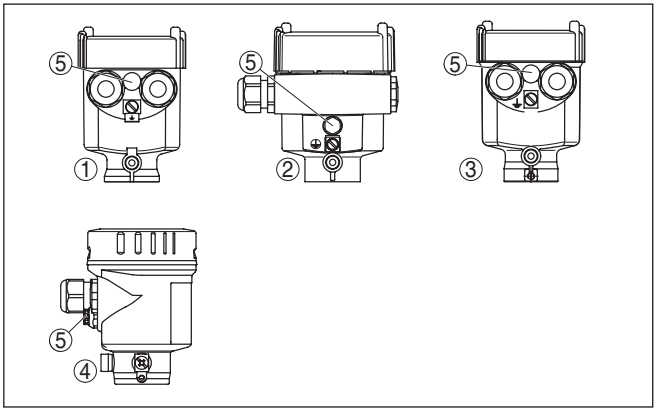


Fig. 8: Material versions, single chamber housing

1 Plastic
2 Aluminium
3 Stainless steel, investment casting
4 Stainless steel, electro-polished
5 Filter element for air pressure compensation of all material versions. Blind plug with version IP 66/IP 68, 1 bar for Aluminium and stainless steel

Electronics and connection compartment

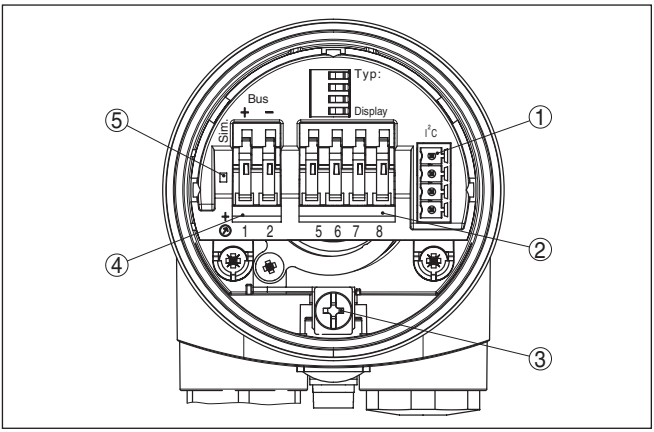


Fig. 9: Electronics and connection compartment, single chamber housing

1 *Plug connector for VEGACONNECT (I^2C interface)*
2 *Spring-loaded terminals for connection of the external indication VEGADIS 61*
3 *Ground terminal for connection of the cable screen*
4 *Spring-loaded terminals for Foundation Fieldbus connection*
5 *Simulation switch ("on" = simulation mode)*

Wiring plan

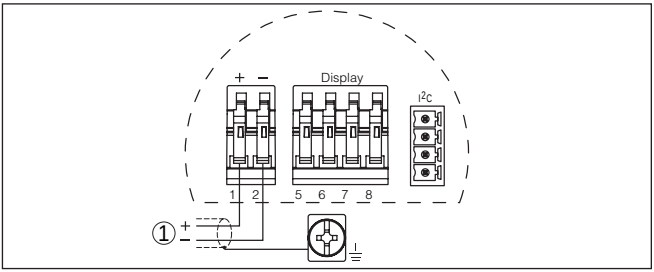


Fig. 10: Wiring plan, single chamber housing

1 *Voltage supply, signal output*

5.4 Wiring plan, double chamber housing

The following illustration apply to non-Ex as well as Ex ia versions. The Exd version is described in the next subchapter.

Housing overview

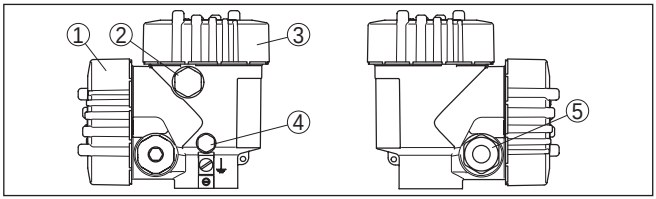


Fig. 11: Double chamber housing

1 Housing cover, connection compartment
2 Blind plug or plug M12 x 1 for VEGADIS 61 (optional)
3 Housing cover, electronics compartment
4 Filter element for air pressure compensation
5 Cable gland

Electronics compartment

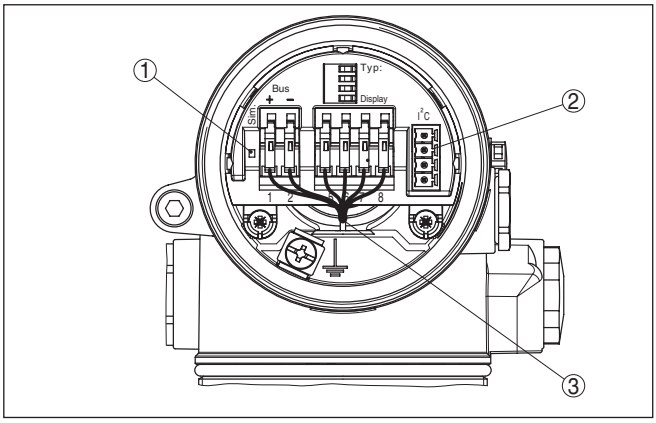


Fig. 12: Electronics compartment, double chamber housing

1 Simulation switch ("on" = simulation mode)
2 Connection for VEGACONNECT (I^2C interface)
3 Internal connection cable to the connection compartment

Connection compartment

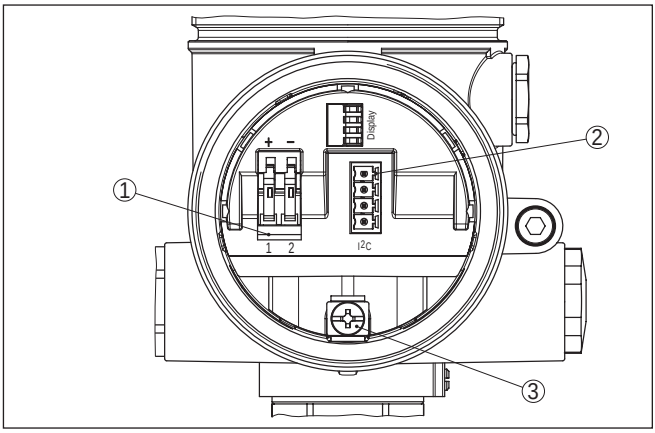


Fig. 13: Connection compartment, double chamber housing

1 Spring-loaded terminals for voltage supply
2 Plug connector for VEGACONNECT (I^2C interface)
3 Ground terminal for connection of the cable screen

Wiring plan

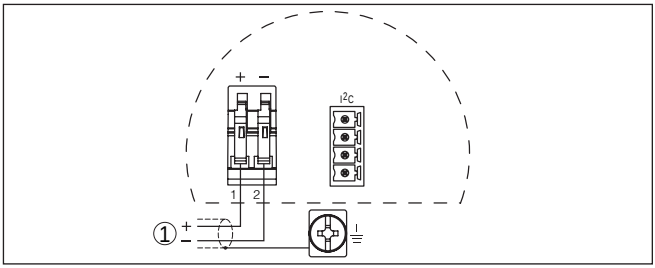


Fig. 14: Wiring plan, double chamber housing

1 Voltage supply, signal output

5.5 Wiring plan, double chamber housing Ex d

Housing overview

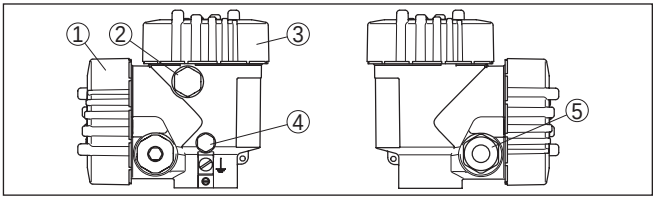


Fig. 15: Double chamber housing

1 Housing cover, connection compartment
2 Blind plug or plug M12 x 1 for VEGADIS 61 (optional)
3 Housing cover, electronics compartment
4 Filter element for air pressure compensation
5 Cable gland

30038-EN-130917

Electronics compartment

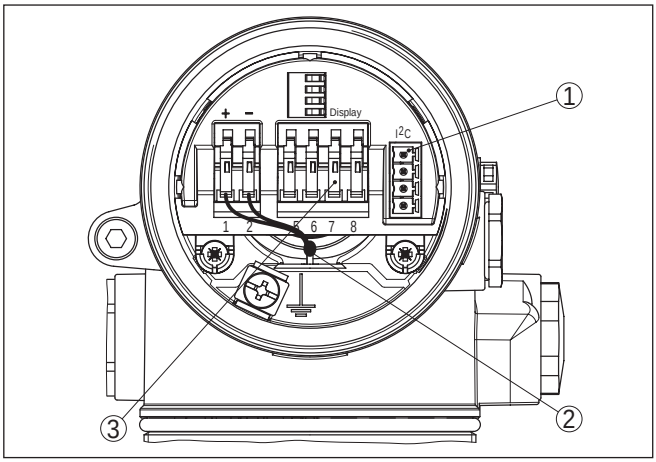


Fig. 16: Electronics compartment, double chamber housing

1 Plug connector for VEGACONNECT (I^2C interface)
2 Internal connection cable to the connection compartment
3 Terminals for VEGADIS 61

Connection compartment

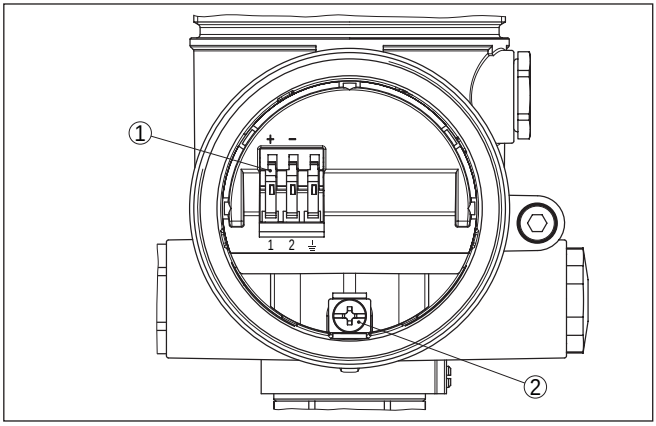


Fig. 17: Connection compartment, Ex-d double chamber housing

1 Spring-loaded terminals for power supply and cable screen
2 Ground terminal for connection of the cable screen

Wiring plan

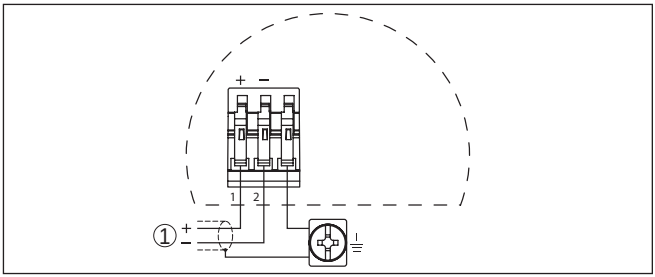


Fig. 18: Wiring plan, Ex-d double chamber housing

1 Voltage supply, signal output

5.6 Wiring plan - version IP 66/IP 68, 1 bar

Wire assignment, connection cable

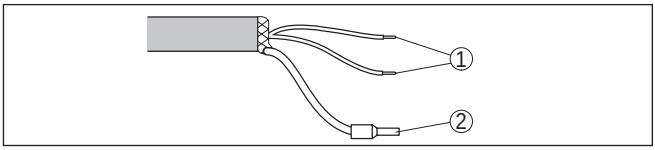


Fig. 19: Wire assignment, connection cable

1 brown (+) and blue (-) to power supply or to the processing system
2 Shielding

6 Set up with the display and adjustment module PLICSCOM

6.1 Short description

Function/Configuration

The display and adjustment module is used for measured value display, adjustment and diagnosis. It can be mounted in the following housing versions and instruments:

- All sensors of the plics® instrument family, in the single as well as in the double chamber housing (optionally in the electronics or connection compartment)
- External display and adjustment unit VEGADIS 61

From a hardware version …- 01 or higher of PLICSCOM as well as a hardware version …- 01, 03 or higher of the corresponding sensor, an integrated backlight can be switched on via the adjustment menu. The hardware version is stated on the type label of the PLICSCOM or the sensor electronics.

Note:
You can find detailed information on the adjustment in the operating instructions manual "*Display and adjustment module*".

6.2 Insert display and adjustment module

Mount/Dismount display and adjustment module

The display and adjustment module can be inserted into the sensor and removed again at any time. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing cover
2. Place the display and adjustment module in the desired position on the electronics (you can choose any one of four different positions - each displaced by 90°)
3. Press the display and adjustment module onto the electronics and turn it to the right until it snaps in.
4. Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The display and adjustment module is powered by the sensor, an additional connection is not necessary.

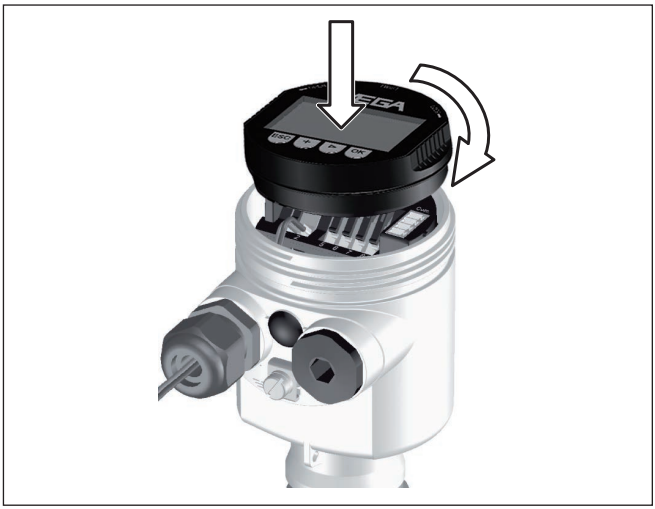


Fig. 20: Insert display and adjustment module

Note:
If you intend to retrofit the instrument with a display and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

6.3 Adjustment system

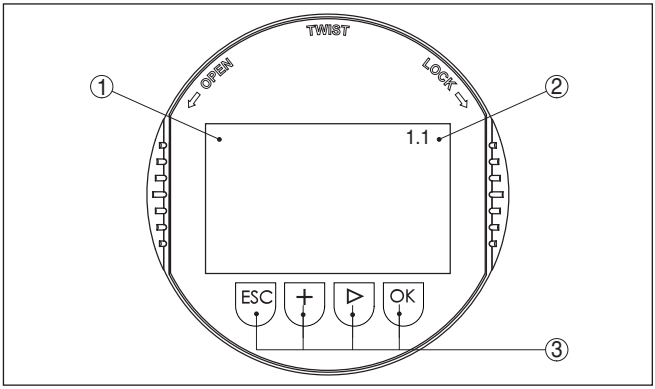


Fig. 21: Display and adjustment elements

1 *LC display*
2 *Indication of the menu item number*
3 *Adjustment keys*

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter

- Save value

- ***[->]*** key to select:
  - Menu change
  - Select list entry
  - Select editing position

- ***[+]*** key:
  - Change value of the parameter

- ***[ESC]*** key:
  - Interrupt input
  - Jump to next higher menu

Adjustment system

The sensor is adjusted via the four keys of the display and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 10 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

6.4 Setup steps

Switch-on phase

After VEGACAL 66 is connected to voltage supply or after voltage recurrence, the instrument carries out a self-check for approx. 30 seconds. The following steps are carried out:

- Internal check of the electronics
- Indication of the instrument type, the firmware as well as the sensor TAGs (sensor designation)
- Status byte goes briefly to fault value

Then the current measured value will be displayed and the corresponding digital output signal will be outputted to the cable.[1)]

Parameter adjustment

VEGACAL 66 measures the capacitance of the respective product. To display the actual level of the product, an allocation of the measured capacitance to the percentage height must be carried out. For this adjustment, the capacitance is entered with emptied and filled vessel.

If the vessel cannot be emptied or filled completely, you can carry out the adjustment also with two known levels - for example with 10 % and 90 %. The difference between the empty and full adjustment values should be as large as possible.

The actual level can then be calculated on the basis of these settings.

VEGACAL 66 must be installed. A change of level is necessary for this adjustment.

In the main menu item "*Basic adjustment*", the individual submenu items should be selected one after the other and provided with the correct parameter values.

[1)] The values correspond to the actual measured level as well as to the settings already carried out, e.g. default setting.

Tip:
If the display and adjustment module remains on the probe as a display, we recommend saving the sensor data in the display and adjustment module.

Use the function "Copy sensor data".

Start your parameter adjustment with the following menu items of the basic adjustment:

Carry out min. adjustment

To be on the safe side, note the adjustment values for full and empty. If an adjustment procedure fails, it is not necessary to again carry out a level change.

These values can be helpful if the electronics has to be exchanged.

	%	Value
Empty adjustment		
Full adjustment		

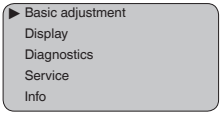
Tab. 1: Adjustment protocol

Tip:
For min. adjustment the vessel should be as empty as possible, and for max. adjustment, as full as possible. If the vessel is already full, start with max. adjustment.

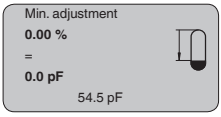
Note:
If possible, the vessel should be as empty as possible for min. adjustment.

Proceed as follows:

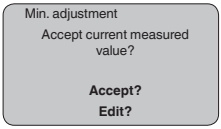
1. Move from the measured value display to the main menu by pushing ***[OK]***.



2. Select the menu item "*Basic adjustment*" with ***[->]*** and confirm with ***[OK]***. Now the menu item "*Min. adjustment*" is displayed.



3. Prepare the adjustment value for editing with ***[OK]***. Move to the selection window with ***[OK]***.



4. Accept the current measured value or move to the editing window with "Edit". To edit, set the cursor to the requested position with

[->]. Set the requested % value with *[+]* and save with *[OK]*. The cursor jumps to the capacitance value.

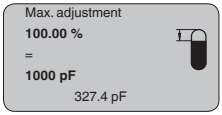
5. Enter the current capacitance value in pF (displayed below) for the empty vessel corresponding to the percentage value.
6. Save the settings with *[OK]* and move to "Max. adjustment" with *[->]*.

Carry out max. adjustment

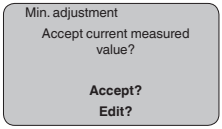
Fill the vessel to the highest possible level.

Note:
For max. adjustment, the vessel should be as full as possible. This will make the calibration more accurate.

Proceed as follows:



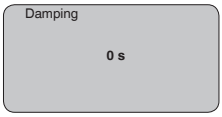
1. Prepare the adjustment value for editing with *[OK]*. Move to the selection window with *[OK]*.



2. Accept the current measured value or move to the editing window with "Edit". To edit, set the cursor to the requested position with *[->]*. Set the requested % value with *[+]* and save with *[OK]*. The cursor jumps to the capacitance value.
3. Enter the current capacitance value in pF (displayed below) for the full vessel corresponding to the percentage value.
4. Save the settings with *[OK]*.

Damping

To suppress fluctuations in the measured value display, e. g. caused by an agitated product surface, a damping can be set. This time can be between 0 and 999 seconds. Keep in mind that the reaction time of the entire measurement will then be longer and the sensor will react to measured value changes with a delay. In general, a period of a few seconds is sufficient to smooth the measured value display.

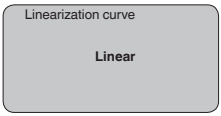


Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the *[->]* key.

Linearization curve

A linearisation is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. in a horizontal cylindrical or spherical tank - and the indication or output of the volume is required. Corresponding linearisation curves are preprogrammed for

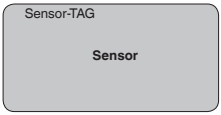
these vessels. They represent the correlation between the level percentage and vessel volume. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".



Enter the requested parameters via the appropriate keys, save your settings and jump to the next menu item with the ***[->]*** key.

Sensor-TAG

In this menu item you can enter an unambiguous designation for the sensor, e.g. the measurement loop name or the tank or product designation. In digital systems and in the documentation of larger plants, a singular designation should be entered for exact identification of individual measuring points.



With this menu item, the Basic adjustment is finished and you can now jump to the main menu with the ***[ESC]*** key.

Optional settings

Additional adjustment and diagnosis options such as e.g. scaling, simulation or trend curve presentation are shown in the following menu schematic. You will find a detailed description of these menu items in the operating instructions manual "*Display and adjustment module*".

Reset

Basic adjustment
If the function "*Reset*" is carried out, the sensor resets all settings to default.

The following values will be reset:

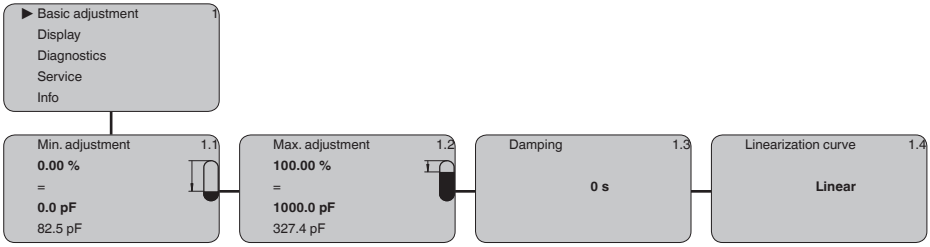
Function	Reset value
Max. adjustment	3000 pF
Min. adjustment	0 pF
Damping ti	0 s
Linearization	Linear
Sensor-TAG	Sensor
Display	AI-Out 1

Special parameters
All special parameters are reset to delivery status.

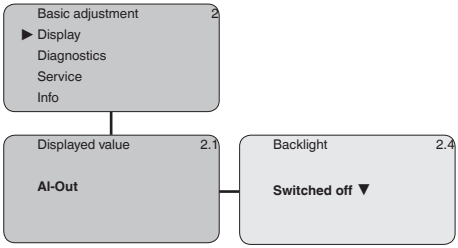
Peak value
The min. and max. values are reset to the actual value.

6.5 Menu schematic

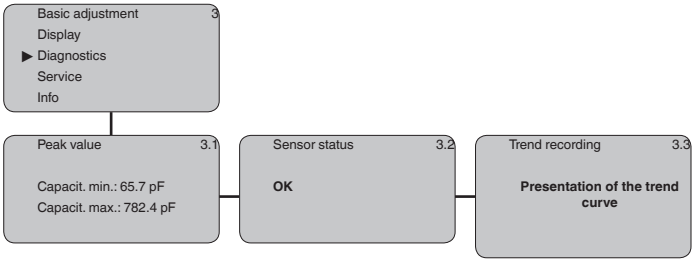
Basic adjustment



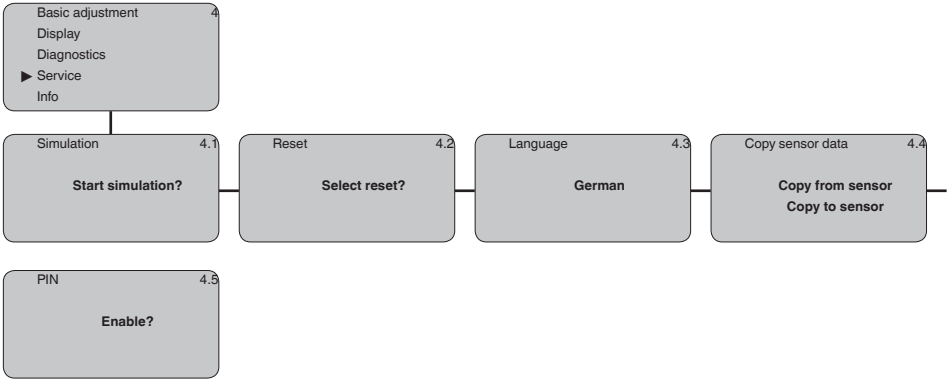
Display



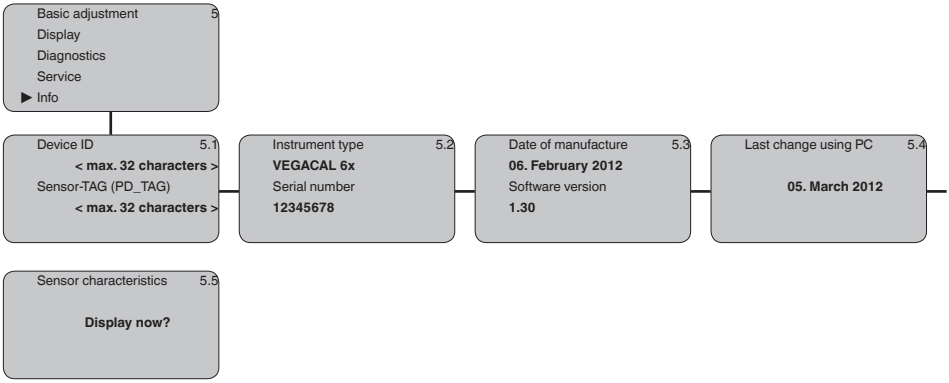
Diagnostics



Service



Info



6.10 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If VEGACAL 66 is equipped with a display and adjustment module, the most important data can be read out of the sensor into the display and adjustment module. The procedure is described in the operating instructions manual "*Display and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

If it is necessary to exchange the sensor, the display and adjustment module is inserted into the replacement instrument and the data are written into the sensor under the menu item "*Copy sensor data*".

7 Set up with PACTware and other adjustment programs

7.1 Connect the PC

VEGACONNECT directly on the sensor

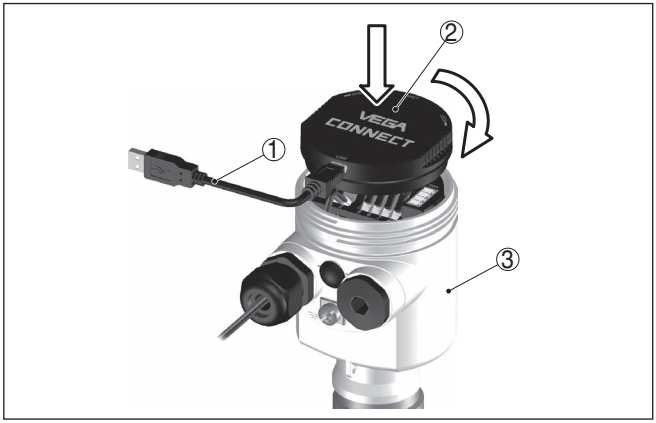


Fig. 22: Connection of the PC via VEGACONNECT directly to the sensor

1 USB cable to the PC
2 VEGACONNECT
3 Sensor

VEGACONNECT externally

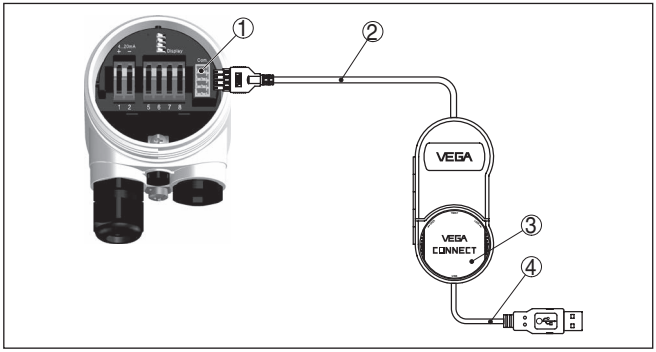


Fig. 23: Connection via VEGACONNECT externally

1 I^2C bus (com.) interface on the sensor
2 I^2C connection cable of VEGACONNECT
3 VEGACONNECT
4 USB cable to the PC

Necessary components:

- VEGACAL 66
- PC with PACTware and suitable VEGA DTM
- VEGACONNECT
- Power supply unit or processing system

7.2 Parameter adjustment with PACTware

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware*" attached to each CD and which can also be downloaded from our homepage. A detailed description is available in the online help of PACTware and the VEGA DTMs.

Note:
Keep in mind that for setup of VEGACAL 66, DTM-Collection in the actual version must be used.

All currently available VEGA DTMs are included as a DTM Collection on a CD. They can be purchased for a token fee from the responsible VEGA agency. In addition, the actual PACTware version is also available on this CD.

In addition, this DTM Collection incl. the basic version of PACTware can be downloaded free of charge from the Internet. Move via www.vega.com and "*Downloads*" to "*Software*".

7.3 Parameter adjustment with AMS™ and PDM

For VEGA sensors, instrument descriptions for the adjustment programs AMS™ and PDM are available as DD or EDD. The instrument descriptions are already implemented in the current versions of AMS™ and PDM.

For older versions of AMS™ and PDM, a free-of-charge download is available via Internet. Move via www.vega.com and "*Downloads*" to "*Software*".

7.4 Saving the parameter adjustment data

It is recommended to document or save the parameter adjustment data. That way they are available for multiple use or service purposes.

The VEGA DTM Collection and PACTware in the licensed, professional version provide suitable tools for systematic project documentation and storage.

8 Maintenance and fault rectification

8.1 Maintenance

If the instrument is used properly, no special maintenance is required in normal operation.

8.2 Rectify faults

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify faults.

Failure reasons

VEGACAL 66 offers maximum reliability. Nevertheless, faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Voltage supply
- Signal processing

Fault rectification

The first measures to be taken are to check the output signals as well as to evaluate the error messages via the display and adjustment module. The procedure is described below. Further comprehensive diagnostics can be carried out on a PC with the software PACTware and the suitable DTM. In many cases, the causes can be determined and the faults rectified this way.

Fault rectification

The first measures to be taken are to check the output signals as well as to evaluate the error messages via the display and adjustment module. The procedure is described below. Further comprehensive diagnostics can be carried out on a PC with the software PACTware and the suitable DTM. In many cases, the causes can be determined and the faults rectified this way.

Checking Profibus PA

The following table describes possible errors and helps to remove them:

Error	Cause	Rectification
When an additional instrument is connected, the segment fails.	Max. supply current of the segment coupler exceeded	Measure the current consumption, reduce size of segment
Wrong presentation of the measured value in Simatic S5	Simatic S5 cannot interpret the number format IEEE of the measured value	Insert converting component from Siemens
In Simatic S7 the measured value is always presented as 0	Only four bytes are consistently loaded in the PLC	Use function component SFC 14 to load 5 bytes consistently

Error	Cause	Rectification
Measured value on the display and adjustment module does not correspond to the value in the PLC	The menu item "*Display - Display value*" is not set to "*PA-Out*"	Check values and correct, if necessary
No connection between PLC and PA network	Incorrect adjustment of the bus parameter and the segment coupler-dependent baud rate	Check data and correct, if necessary
Instrument does not appear during connection setup	Profibus DP cable pole-reversed	Check cable and correct, if necessary
	Incorrect termination	Check termination at the beginning and end points of the bus and terminate, if necessary, according to the specification
	Instrument not connected to the segment, double assignment of an address	Check and correct, if necessary

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Error messages via the display and adjustment module

Error	Cause	Rectification
E013	no measured value available	– Probe insulation damaged, short-circuit due to permeating, conductive medium – Exchange the instrument or send it in for repair
	Shortcircuit in the probe, e.g. because of moisture in the housing	– Remove the electronics module out of the probe and check the resistor between the two marked plug connections according to the figure in paragraph "*Check the resistance in the probe*". – There should be no contact between any of the connections (high resistance) – If there is still a connection - exchange the instrument or return it for repair
E017	Adjustment span too small	Carry out a fresh adjustment and increase the distance between min. and max. adjustment
E036	no operable sensor software	Carry out a software update or send instrument for repair
E113	Communication conflict	Exchange the instrument or send it in for repair

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Set up*" may have to be carried out again.

8.3 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications only one instrument and one electronics module with respective Ex approval may be used.

If there is no electronics module available on site, one can be ordered from the VEGA agency serving you.

Sensor serial number

The new electronics module must be loaded with the order data of the sensor. These are the options:

- At the factory by VEGA
- Or on site by the user

In both cases, the sensor serial number is needed. The serial numbers are stated on the type label of the instrument or on the delivery note.

Information:
When loading on site, first of all the order data must be downloaded from the Internet (see operating instructions manual "*Electronics module*").

Assignment

The electronics modules are adapted to the respective sensor and differ in their signal output or in their power supply. You can find a suitable electronics module in the following overview.

The oscillators differ only in their signal output and are suitable for all series 60 sensors.

The following types are available:

- CL-E60**H** (4 … 20 mA/HART)
- CL-E60**P** (Profibus PA)
- CL-E60**F** (Foundation Fieldbus)

In Ex applications only an electronics module with respective Ex approval may be used.

8.4 How to proceed in case of repair

You can find a repair form as well as detailed information on how to proceed under www.vega.com/downloads and "*Forms and certificates*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

If a repair is necessary, please proceed as follows:

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please contact for the return shipment the agency serving you. You can find the agency on our home page www.vega.com.

9 Dismounting

9.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel or pipeline, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

9.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the parts to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

10 Supplement

10.1 Technical data

General data

Material 316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Process fitting - thread	316L
– Process fitting - flange	316L
– Process seal	Klingersil C-4400
– insulation (fully insulated)	PTFE
– Gravity weight	316L
Materials, non-wetted parts	
– Probe (cable fully PTFE insulated: ø 8 mm/0.315 in)	316L
– Plastic housing	plastic PBT (Polyester)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing - precision casting	316L
– Stainless steel housing, electropolished	316L
– Seal between housing and housing cover	NBR (stainless steel housing, precision casting), silicone (aluminium/plastic housing; stainless steel housing, electropolished)
– Ground terminal	316L
Process fittings	
– Pipe thread, cylindrical (DIN 3852-A)	G1 A, G1½ A
– American pipe thread, conical (ASME B1.20.1)	1 NPT, 1½ NPT
– Flanges	DIN from DN 50, ANSI from 2"
Weight	
– Instrument weight (depending on process fitting)	0.8 … 4 kg (0.18 … 8.82 lbs)
– Gravity weight	900 g (32 oz)
– Cable weight: ø 8 mm (0.315 in)	180 g/m (1.9 oz/ft)
Sensor length (L)	0.4 … 32 m (1.312 … 105 ft)
Max. tensile load (cable)	
– PTFE fully insulated: ø 8 mm (0.315 in)	10 KN (2248 lbf)
Max. torque (process fitting - thread)	100 Nm (74 lbf ft)

Output variable

Output

– Signal	digital output signal, Foundation Fieldbus protocol
– Physical layer	according to IEC 61158-2
Channel Numbers	
– Channel 1	Primary value
– Channel 2	Secondary value 1
– Channel 3	Secondary value 2
Transmission rate	31.25 Kbit/s
Current value	10 mA, ±0.5 mA
Damping (63 % of the input variable)	0 … 999 s, adjustable

Input variable	
Measured variable	Level of conductive liquids and solids
Measuring principle	phase-selective admittance processing (PSA)
Measuring range	0 … 3000 pF
Measuring frequency	270 kHz

Accuracy (according to DIN EN 60770-1)	
Reference conditions according to DIN EN 61298-1	
– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %
– Air pressure	860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psig)
Temperature error	
– < 120 pF	< 1 pF
– > 120 pF	1 % of the current measured value
Linearity error	< 0.25 % of the complete measuring range

Ambient conditions	
Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

Process conditions	
Process pressure	-1 … 40 bar/-100 … 4000 kPa (-14.5 … 580 psig)
Process temperature VEGACAL 66 of 316L	-50 … +150 °C (-58 … +302 °F)

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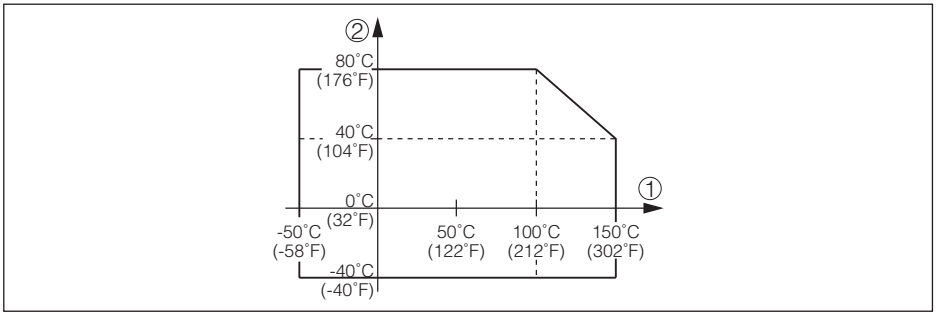

Fig. 24: Ambient temperature - Process temperature

1 Process temperature
2 Ambient temperature

Dielectric constant	≥ 1.5

Electromechanical data - version IP 66/IP 67 and IP 66/IP 68; 0.2 bar

Cable entry/plug[2)]	
– Single chamber housing	– 1 x cable gland M20 x 1.5 (cable: ø 5 … 9 mm), 1 x blind plug M20 x 1.5 or: – 1 x closing cap M20 x 1.5; 1 x blind plug M20 x 1.5 or: – 1 x closing cap ½ NPT, 1 x blind plug ½ NPT or: – 1 x plug (depending on the version), 1 x blind stopper M20 x 1.5
– Double chamber housing	– 1 x cable entry M20 x 1.5 (cable: ø 5 … 9 mm), 1 x blind plug M20 x 1.5; 1 x blind plug M16 x 1.5 or optionally available with 1 x plug M12 x 1 for external display and adjustment unit or: – 1 x closing cap ½ NPT, 1 x blind plug ½ NPT, 1 x blind plug M16 x 1.5 or optionally 1 x plug M12 x 1 for external display and adjustment unit or: – 1 x plug (depending on the version), 1 x blind plug M20 x 1.5; 1 x blind plug M16 x 1.5 or optionally available with 1 x plug M12 x 1 for external display and adjustment unit
Spring-loaded terminals for wire cross-section	< 2.5 mm² (AWG 14)

Electromechanical data - version IP 66/IP 68 (1 bar)

Cable entry	
– Single chamber housing	1 x IP 68 cable gland M20 x 1.5; 1 x blind plug M20 x 1.5

[2)] Depending on the version M12 x 1, according to DIN 43650, Harting, 7/8" FF.

– Double chamber housing	1 x IP 68 cable gland M20 x 1.5; 1 x blind stopper M20 x 1.5; 1 x blind stopper M16 x 1.5
Connection cable	
– Wire cross-section	0.5 mm² (AWG 20)
– Wire resistance	< 0.036 Ω/m (0.011 Ω/ft)
– Tensile strength	< 1200 N (270 lbf)
– Standard length	5 m (16.4 ft)
– Max. length	1000 m (3280 ft)
– Min. bending radius	25 mm (0.984 in) with 25 °C (77 °F)
– Diameter approx.	8 mm (0.315 in)
– Colour - standard PE	Black
– Colour - standard PUR	Blue
– Colour - Ex-version	Blue

Display and adjustment module

Voltage supply and data transmission	through the sensor
Indication	LC display in dot matrix
Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– mounted into the sensor without cover	IP 40
Material	
– Housing	ABS
– Inspection window	Polyester foil

Voltage supply

Operating voltage	
– Non-Ex instrument	9 … 32 V DC
– Ex-ia instrument	9 … 24 V DC
– Ex-d instrument	16 … 32 V DC
Operating voltage with illuminated display and adjustment module	
– Non-Ex instrument	12 … 32 V DC
– Ex-ia instrument	12 … 24 V DC
– Ex-d instrument	20 … 32 V DC
Power supply by/max. number of sensors	
– Fieldbus	max. 32 (max. 10 with Ex)

Electrical protective measures

Protection, depending on housing version	
– Plastic housing	IP 66/IP 67

– Aluminium housing, stainless steel housing - investment casting, stainless steel housing - electro-polished	IP 66/IP 68 (0.2 bar)[3]
– Aluminium and stainless housing, investment casting (optionally available)	IP 66/IP 68 (1 bar)
Overvoltage category	III
Protection class	II

Approvals

Instruments with approvals can have different technical data depending on the version.

For that reason the associated approval documents of these instruments have to be carefully noted. They are part of the delivery or can be downloaded under www.vega.com via "*VEGA Tools*" and "*serial number search*" as well as via "*Downloads*" and "*Approvals*".

10.2 Foundation Fieldbus

Block diagram, measured value processing

The following illustration shows the Transducer Block (TB) and Function block (FB) in simplified form.

[3] A suitable cable is the prerequisite for maintaining the protection rating.

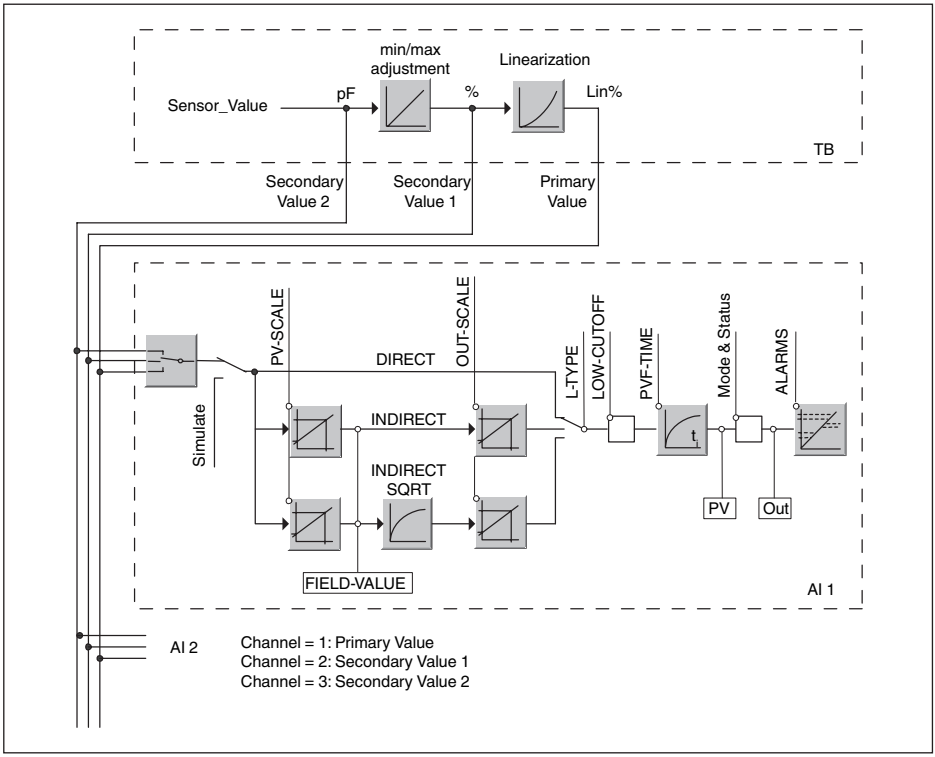

Fig. 25: VEGACAL 66 measured value processing

Diagram, adjustment

The following illustration shows the function of the adjustment:

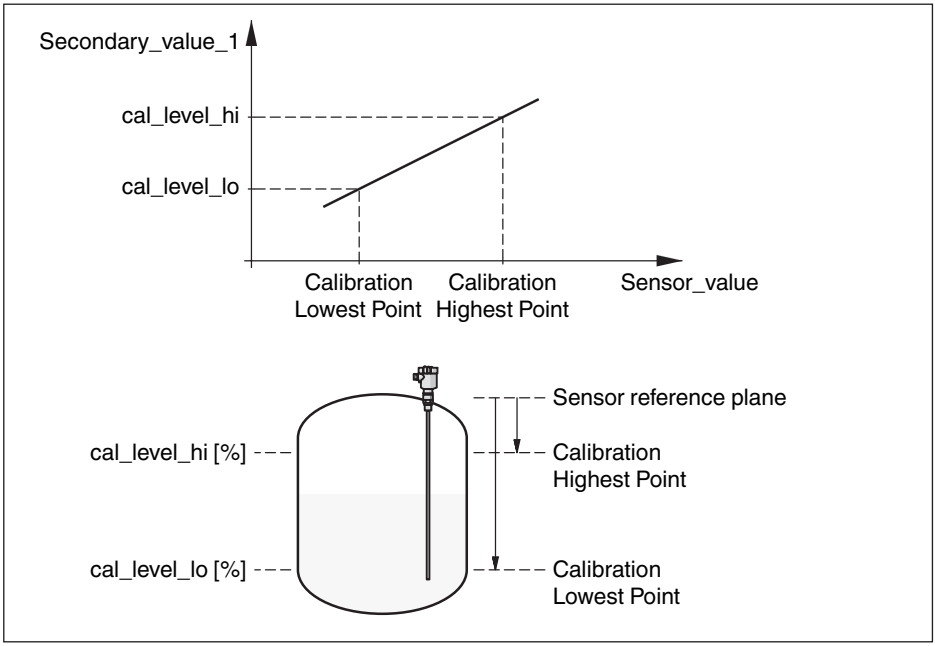

Fig. 26: Adjustment VEGACAL 66

Parameter list

The following list contains the most important parameters and their meaning:

- primary_value
  - This is the process value after adjustment and Linearization with the status of the transducer block
  - It is the input for the AIFB when CHANNEL = 1 is selected
  - The unit is defined in "primary_value_unit"
- primary_value_unit
  - Selected unit code for "primary_value"
- secondary_value_1
  - This is the process value after adjustment with the status of the transducer block
  - It is the input for the AIFB when CHANNEL = 2 is selected
  - The unit is defined in "secondary_value_2_unit"
- secondary_value_1_unit
  - Selected unit code for "secondary_value_1"
- secondary_value_2
  - This is the distance value (sensor_value) with the status of the transducer block
  - It is the input for the AIFB when CHANNEL = 3 is selected
  - The unit is defined in "secondary_value_2"
- secondary_value_2_unit
  - Selected unit code for "secondary_value_2"
- sensor_value
  - This is the distance value of the sensor
  - The unit is defined in "sensor_range.Units Index"
- sensor_range

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  - "sensor_range.Units Index" is the unit for "sensor_value", "max/min_peak_sensor_value", "Calibration Highest/Lowest Point" and "empty_vessel_ocrr_dist"
- simulate_primary_value
- simulate_secondary_value_1
- simulate_secondary_value_2
- Linearization Type
  - Linearization Type, the selectable types are: Linear, User def; Cylindric lying container, Spherical container
- tab_op_code
- tab_index
- tab_max_number
- tag_min_number
- tab_actual_number
- tab_status
- tab_x_y_value
- display_source_selector
  - Selects the type of value, which is displayed on the indicating and adjustment module
- max_peak_sensor_value
  - Holds the maximum "sensor_value". The unit is defined in "sensor_range.Units Index"
- min_peak_sensor_value
  - Holds the minimum "sensor_value". The unit is defined in "sensor_range.Units Index"
- Calibration Highest Point
  - Min./Max. adjustment: this is the upper calibrated point of the sensor_value. It refers to "cal_level_hi".
  - The unit is defined in "sensor_range.Units Index"
- Calibration Lowest Point
  - Min./Max. adjustment: this is the lower calibrated point of the sensor_value. It refers to "cal_level_lo".
  - The unit is defined in "sensor_range.Units Index"
- cal_level_hi
  - Min./Max. adjustment: this is the value of level at "Calibration Highest Point". The unit is defined in "level_unit.
  - When writing "cal_level_hi" and "cal_type" = 1, the "Calibration Highest Point" is automatically set to "sensor_value"
- cal_level_lo
  - Min./Max. adjustment: this is the value of level at "Calibration Lowest Point". The unit is defined in "level_unit"
  - When writing "cal_level_lo" and "cal_type" = 1, the "Calibration Lowest Point" is automatically set to "sensor_value"
- cal_type
  - Min./Max. adjustment: this parameter defines the type of calibration:
  - Dry: no influence of "sensor_value" on level calibration
  - Online: current "sensor_value"determines "Calibration Highest/Lowest Point"
- level
- level_unit
- level_offset
- sensor_offset
- phase_angle_select
  - set up to suit the process conditions
- epsilon_r
  - set up to suit the process conditions
- product_type
  - set up to suit the process conditions

- electrode_type
  – set up to suit the process conditions

10.3 Dimensions

Housing in protection IP 66/IP 68 (0.2 bar)

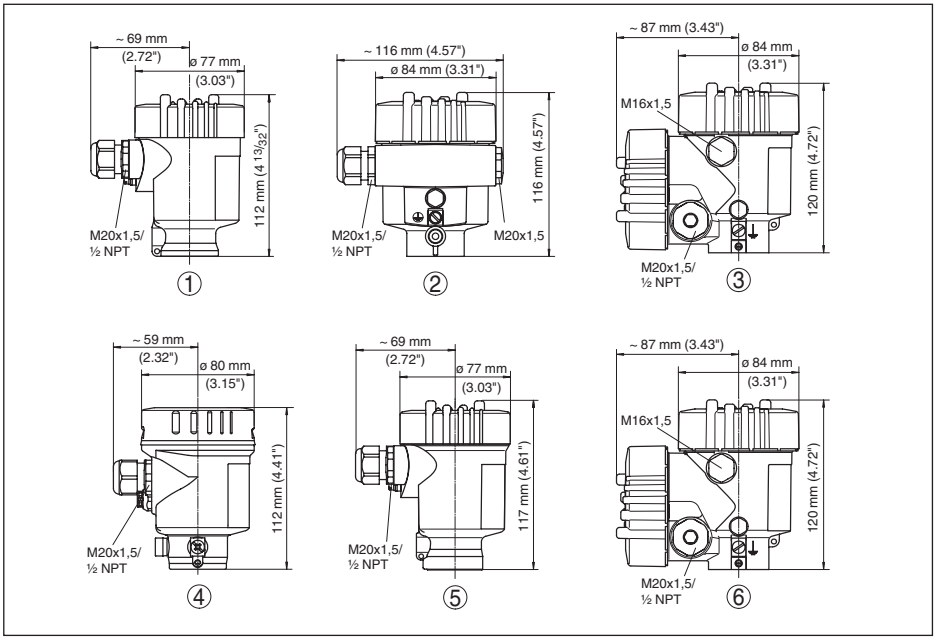

Fig. 27: Housing versions in protection IP 66/IP 68 (0.2 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Plastic housing
2 Aluminium housing
3 Aluminium double chamber housing
4 Stainless steel housing, electropolished
5 Stainless steel housing - precision casting
6 Stainless steel double chamber housing - precision casting

Housing in protection IP 66/IP 68 (1 bar)

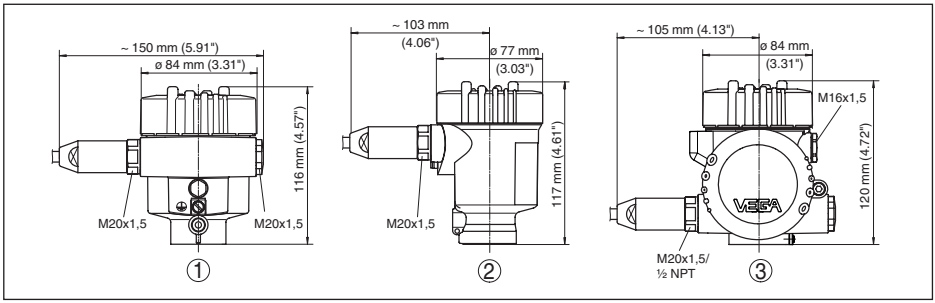

Fig. 28: Housing versions in protection IP66/IP68 (1 bar) - with integrated display and adjustment module the housing is 9 mm/0.35 in higher

1 Aluminium housing
2 Stainless steel housing - precision casting
2 Stainless steel double chamber housing - precision casting

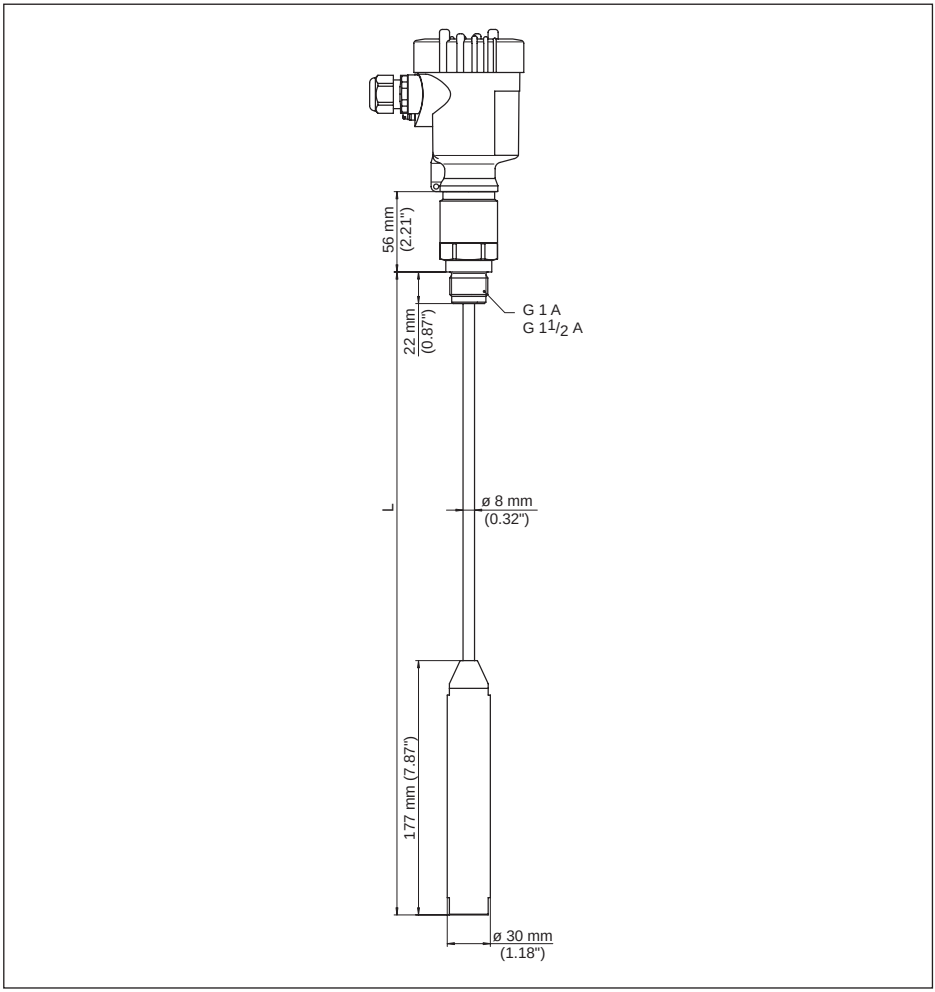

Fig. 29: VEGACAL 66, threaded version G1 A (ISO 228 T1)

L = Sensor length, see chapter "Technical data"

10.4 Industrial property rights

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